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CHACKO DAVIS, DABORAH				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/688,337

Applicant(s)

BORODOVSKY, YAN

Examiner

DABORAH CHACKO DAVIS

Art Unit

1795

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 16-28 and 37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 16-28 and 37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/S508)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-7, 16-20, are rejected under 35 U.S.C. 102(b) as being anticipated by U. S. Patent No. 4,517,280 (Okamoto et al., hereinafter referred to as Okamoto) in view of U. S. Patent Application Publication No. 2003/0091940 (Nakao).

Okamoto, in col 3, lines 12-54, discloses a method of patterning a substrate by forming a photoresist layer on the substrate, performing a first exposure by holographic exposure (interference lithography) to form an array of repeating line and space patterns (grating pattern, in a first photoresist layer), performing a second exposure via a mask (see figure 3(3)), thereby introducing irregularity (imparting the mask pattern or arbitrary arrangement) into the already formed repeating line and space patterns, i.e., reducing or ending the continuity of the array of the line and space pattern (grating pattern or trench pattern) (claims 1, 4, 16-17). Okamoto, in col 3, lines 25-55, and in figure 3, discloses forming an arbitrary figure (see reference B in figure 3(4), a second photoresist mask formed in a second photoresist layer) above or in some portion of the array of line and space patterns (grating), and etching (patterning) the substrate through portions not covered by the second photoresist mask B (arbitrary figure) using the arbitrary arrangement (directs the etching or selective etching) i.e., reducing the

continuity of the array of patterns by cutting spaces in the array and imparting or transferring the photomask or resist mask pattern onto the substrate (claims 2-3, 5, 7, 18-20).

The difference between the claims and Okamoto is that Okamoto does not disclose that the arbitrary figure comprises a first feature and a second feature that noncontiguous and that each bridge one or more of the repeating lines and spaces at different longitudinal positions. Okamoto does not disclose that the line and space patterns were formed via projection lithography patterning.

Nakao, in [0129], [0130], [0131], [0132], [0133], [0134], [0135], [0136], and in figures 35A, 35B, and 35C, discloses that the patterns transferred to the resist layer from the second photomask introduces irregularity such that features (first, second , third etc) that are noncontiguous and in longitudinal positions and bridging the initially formed line and space patterns are formed. Nakao, in [0058]-[0065], and figure 5, discloses that a stepper (projection lithographic patterning process) is used to form the line and space patterns.

Therefore, it would be obvious to a skilled artisan to modify Okamoto by employing the method of introducing irregularity into the line and space patterns in a manner suggested by Nakao because Okamoto, in col 5, lines 5-20, discloses that diffraction gratings of different periods and directions (lateral or longitudinal) in more than one region can be formed by repeating the process (coating photoresist, exposure, development etc) several times. It would be obvious to a skilled artisan to modify Okamoto by employing the stepper to form the line and space patterns as suggested by

Nakao because Nakao, in [0058], discloses that using a stepper such as a reduction projection exposure apparatus enables the formation of reduced patterns on the photoresist material.

3. Claims 8, and 21, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 4,517,280 (Okamoto et al., hereinafter referred to as Okamoto) in view of U. S. Patent Application Publication No. 2003/0091940 (Nakao), as applied to claims 1-7, and 16-20, above, and further in view of EP 0915384 (Sugita et al., hereinafter referred to as Sugita).

Okamoto in view of Nakao is discussed in paragraph no. 2.

The difference between the claims and Okamoto in view of Nakao is that Okamoto in view of Nakao does not disclose the patterning of the substrate with the arbitrary arrangement uses a pitch yielding a k_1 factor smaller than 0.4 (claim 8). Okamoto in view of Nakao does not disclose that the first interference exposure process uses a pitch that yields a k_1 factor approaching 0.25 (claim 21).

Sugita, in col 4, lines 1-41, discloses using a k_1 factor of less than 0.4 and that a k_1 factor as low as 0.25 can be used in an interference exposure process.

Therefore, it would be obvious to a skilled artisan to modify Okamoto in view of Nakao by employing the pitch that generates the claimed k_1 factor as suggested by Sugita because Sugita, in col 3, lines 33-56, and in col 4, lines 1-15, discloses that the using the claimed k_1 factor i.e., less than 0.5 in an exposure process enables a higher

resolution in the pattern and produces a fine periodic pattern that corresponds to the intensity distribution of the impinged light on the wafer.

4. Claims 22-28, and 37, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 4,517,280 (Okamoto et al., hereinafter referred to as Okamoto) in view of U. S. Patent Application Publication No. 2003/0091940 (Nakao) and EP 0915384 (Sugita et al., hereinafter referred to as Sugita).

Okamoto, in col 3, lines 12-54, discloses a method of patterning a substrate by forming a photoresist layer on the substrate, performing a first exposure (first lithographic technique) by holographic exposure (interference lithography) to form an array of repeating line and space patterns (grating pattern, in a first photoresist layer) having a first pitch, performing a second exposure via a mask (see figure 3(3), a second lithographic technique), thereby introducing irregularity or imparting a second pattern with a second pitch into the already formed repeating line and space patterns, i.e., reducing or ending the continuity of the array of the line and space pattern (grating pattern, eliminating the impact of some of the line and space pattern portions on the substrate) and wherein the second pitch is more than twice that of the first pitch (see figure 3) (claims 22-24, and 26). Okamoto, in col 3, lines 34-40, and in figure 3 (3), discloses performing a second exposure on the line and space pattern using a binary mask (a mask with part of the mask providing a light shielding section and the remaining part of the mask is a transparent section) so as to eliminate the impact (continuity) of the array of patterns (claim 25). Okamoto, in col 3, lines 25-55, and in figure 3,

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discloses forming an arbitrary figure (see reference B in figure 3(4), a second photoresist mask) above or in some portion of the array of line and space patterns (grating), and etching (patterning) the substrate through portions not covered by the second photoresist mask B (arbitrary figure) using the arbitrary arrangement (directs the etching or selective etching, transferring a superposition) i.e., ending the continuity of the array of the line and space patterns or eliminating the impact of some portions of the line and space patterns by etching the exposed areas (not covered by the arbitrary figure viz., mask)(claims 27-28, and 37).

The difference between the claims and Okamoto is that Okamoto does not disclose that a first feature, a second feature and a third feature is introduced in the photoresist layer in a noncontiguous manner and that each bridge one or more of the repeating lines and spaces at different longitudinal positions (first, second, and third longitudinal positions), and transferring the superpositions of each of the first, second and third features into the substrate. Okamoto is that Okamoto does not disclose that the first exposure process uses a pitch that yields a k_1 factor smaller than or equal to 0.5. Okamoto does not disclose that the first pitch yields a first k_1 factor approaching 0.25. Okamoto does not disclose that the second pitch yields a second k_1 factor greater than 0.5.

Nakao, in [0129], [0130], [0131], [0132], [0133], [0134], [0135], [0136], and in figures 35A, 35B, and 35C, discloses that the patterns transferred to the resist layer from the second photomask introduces irregularity such that features (first, second , third etc) that are noncontiguous and in corresponding first, second, and third

longitudinal positions and bridging the initially formed line and space patterns, and transferring the corresponding superpositioned patterns into the underlying substrate (see figures 35A through 35C, and figures 36-44).

The difference between the claims and Okamoto in view of Nakao is that Okamoto in view of Nakao does not disclose that the first exposure process uses a pitch that yields a k_1 factor smaller than or equal to 0.5. Okamoto in view of Nakao does not disclose that the first pitch yields a first k_1 factor approaching 0.25. Okamoto in view of Nakao does not disclose that the second pitch yields a second k_1 factor greater than 0.5.

Sugita, in col 4, lines 1-15, discloses using a k_1 factor of less than 0.5 in an interference exposure process. Okamoto, in col 4, lines 16-20, discloses that a lithographic process can be performed using a k_1 factor greater than 0.5.

Therefore, it would be obvious to a skilled artisan to modify Okamoto by employing the method of introducing irregularity into the line and space patterns in the manner suggested by Nakao because Okamoto, in col 5, lines 5-20, discloses that diffraction gratings of different periods and directions (lateral or longitudinal) in more than one region can be formed by repeating the process (coating photoresist, exposure, development etc) several times. It would be obvious to a skilled artisan to modify Okamoto in view of Nakao by employing the pitch that generates the claimed k_1 factor as suggested by Sugita because Sugita, in col 3, lines 33-56, and in col 4, lines 1-15, discloses that the using the claimed k_1 factor i.e., at least less than 1.0 in an exposure

process enables a higher resolution in the pattern and produces a fine periodic pattern that corresponds to the intensity distribution of the impinging light on the wafer.

Response to Arguments

5. Applicant's arguments, see Remarks, filed January 3, 2008, have been fully considered but they are not persuasive. The 103 rejections made in the previous office action (paper no. 20071015) are maintained.

A) Applicants argue that none of Okamoto nor Nakao nor Sugita teaches noncontiguous first and second features that bridge one or more of the repeating lines and spaces of the array at different longitudinal positions.

Okamoto is relied upon to disclose the formation of line and space patterns via the first exposure. Okamoto also teaches introducing irregularity on the already formed line and space patterns see figure 3(5). Nakao is relied upon to teach the method of patterning the second photoresist layer with a photomask (i.e., introducing irregularity using an arbitrary figure that comprises features of line and spaces) wherein the second photoresist layer is formed on the array (line and space pattern) such that first, second, third etc., features are formed in different longitudinal positions while bridging the line and space patterns. See figures 35 A through C, the different line and space patterns are bridging the initially formed line and space pattern at different longitudinal positions. Sugita is not relied upon to disclose this limitation.

B) Applicants argue that none of Nakao's bright lines bridge (relatively large) one another.

Nakao refers to the lines as fine bright lines with relatively small linewidths (see paragraph [0127]. Nakao's lines are formed on the previously formed line and space patterns and therefore are bridging one another.

C) Applicants argue that it would not be obvious to combine Okamoto, Nakao or Sugita to arrive at the recited subject matter i.e., to break continuity of a collection of repeating lines and spaces provided in a first layer using bridging features in a photoresist layer.

Okamoto teaches forming a first line and space patterns on a first photoresist layer that are then coated with another photoresist layer to introduce irregularity in the already formed first line and space pattern. Okamoto is not solely relied upon to teach the claimed subject matter. Nakao teaches patterning a first line and space pattern, and then forming and patterning a second photoresist layer that disrupts or introduces irregularity to the underlying first line and space pattern, wherein the disruption introduced is another line and space pattern that bridges the previously existing line and space patterns. Both Okamoto and Nakao teach introducing irregularity to previously existing line and space patterns, and Okamoto suggests that gratings (such as line and space patterns) of different periods and directions (oriented in either lateral or longitudinal directions) can be formed by repeating the process i.e., applying subsequent photoresist layers, exposing, developing etc. Sugita is not relied upon to

disclose the argued subject matter. Sugita is relied upon to disclose the claimed resolution factor "k₁".

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daborah Chacko-Davis whose telephone number is (571) 272-1380. The examiner can normally be reached on M-F 9:30 - 6:00. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status

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information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

dcd

/Daborah Chacko-Davis/
Examiner, Art Unit 1795

March 27, 2008.

**/Mark F. Huff/
Supervisory Patent Examiner, Art Unit 1795**